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To EB of CDM

Please find below the response to the Request for Review for the CDM project "Yunnan Nujiang Fugong Guquan River Hydropower Station". In case you have any further inquiries please do not hesitate to contact us.

Best regards

Thomas Kleiser

Thomas Kleiser

Head of Certification Body "Climate and Energy"
Carbon Management Service

Enclosures:

1) The power generation of the project in 2008
2) Notice of explanation on the Coefficient of Effective Electricity from local Grid Company
3) Explanation of the Coefficient of effective electricity

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Response to the CDM Executive Board

REQUEST No.1:

The DOE is requested to clarify how it has validated the investment analysis in particular, the appropriateness of a benchmark issued 1995 when assessing the additionality of a project with investment decision made in 2005.

Response from the Project Participant:

The project compares the IRR against the 10% benchmark (project IRR post-tax) as per the "The Economic Evaluation Code for Small Hydropower Projects (SL16-95)", which is applicable to hydropower stations with an installed capacity no more than 50MW. This document is part of the "Professional Standards of the People's Republic of China" and was approved and published by the Ministry of Water Resources of the People's Republic of China in 1995. [1] Since then, no new documents prescribing benchmarks for hydropower stations with an installed capacity up to 50MW have been released by the Government of China, nor has the validity of this benchmark been repudiated in any way. In fact, its applicability was confirmed by the Ministry of Water Resources of the People's Republic of China in 2002 in the "Bulletin of Valid Hydropower Technical Standards No 07 (2002)".[2] Additionally, the Water Resources and Hydropower Planning and Design General Institute of the Ministry of Water Resources of the People's Republic of China confirm that this benchmark is still in effect in 2008.[3]

In addition, the 10% benchmark is still ubiquitously applied by stakeholders of hydropower projects with an installed capacity up to 50MW (e.g. Design Institutes, Investors, governments in charge of approving projects) to evaluate the feasibility of these projects. And, Chinese DNA's approval of CDM project activities with an IRR below this benchmark indicates it is still valid.

The installed capacity of the project is 22MW lower than 50MW, therefore, the benchmark of 10% in the document SL16-95 as mentioned above is applicable to the project as SL16-95 is applicable to hydropower stations with an installed capacity no more than 50MW.

In addition, the fact that the "The Economic Evaluation Code for Small Hydropower Projects (SL16-95)" is still appropriate is confirmed and reinforced by the fact that the Feasibility Study Report of the proposed project activity specifically mentions the SL16-95.

For the above reasons, the 10% benchmark is the most adequate that can be and is widely applied. Therefore, the project appropriately employs the benchmark of 10% based on the document SL16-95.

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[1] http://www.cws.net.cn/guifan/bz/SL16-95/
[2] http://www.ches.com.cn/jishubiaozhun/001.htm
[3] http://www.giwp.org.cn/index.do?act=mess&modu=160&mess=361

Response by DOE:

The applied benchmark for the proposed project activity is as provided by the "Economic evaluation code for small hydropower projects" (Document No.SL16-95) issued in 1995, in which it is mentioned that *"This evaluation code is applied for small hydropower projects with installed capacity no more than 25MW (all newly-built, expansion, modification or retrofit projects* and *hydropower stations with installed capacity no more than 50MW in the rural area)".*
The Ministry of Water Resources accordingly has issued a Bulletin on Effective Technical Standard in Hydropower and Water Resource Industry on June 18th 2002 and another on September 9th 2006 to confirm the validity of this standard and its specification (IRL 31). The "Economic Evaluation Code for Small Hydropower Projects" (Document No.SL16- 95) issued in 1995 is indicated as valid in both of these Bulletins.

Having confirmed the validity of the SL16-95 both in 2002 and 2006 it is concluded that it was also valid in 2005, when the investment decision was taken.

Furthermore, TÜV SÜD can confirm, based on its local experience and expertise in this sector, that this benchmark is pretty common and widely applied in China for this type of project.
As a result, TÜV SÜD is confident that the 10% benchmark is appropriately applied and can be considered as suitable for the proposed project activity under consideration.

In the Feasibility Study Report (IRL No. 7) and in the PDD, the IRR of the proposed project is specified as 8.26 % after tax. This is lower than the benchmark of 10% as stipulated in SL16-95.

Section 4.3 of SL16-95 later states that:
"In the financial assessment, if the calculated FIRR is higher than or equivalent to the financial benchmark rate of return (Ic) for small-scale hydropower projects, it is believed that the project is financially feasible. The financial benchmark rate of return (Ic) for small-scale hydropower projects is set at 10%."

In conclusion, TÜV SÜD can confirm that the applied benchmark of 10% is considered as an acceptable basis for comparing the calculated project IRR indicated in the FSR and the PDD.

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REQUEST No.2:

The PDD states that the expected annual power generation is 117,720 MWh. However, the net export to the grid is 99,560 MWh. This loss of 15% of power generation should be further explained.

Response from the Project Participant:

The loss of about 15.5% [4] is caused by the poor load of local grid (the coefficient of effective electricity [5] of local hydropower stations is only 85%) and the auxiliary power consumption (0.5%).

The designed annual power generation and the net power exported to the grid are both from the approved Feasibility Study Report, which completed by the "Yunnan Lingyu Water Resource and Hydropower Investigation and Design Institute" [6], therefore, the two values are applicable and credible.

As described in PDD requesting registration,
- ✧ The average expected/designed annual power generation is 117,720MWh, which was estimated in Feasibility Study Report according to the hydrological conditions in terms of water resource availability (30 years), does therefore differ from the actual power which will be generated, because full load conditions will be rarely set during the plant operation throughout the year due to the lack of absorption capability of the grid.
- ✧ And the net power exported to the grid is estimated to be 99,560MWh.

The net power exported to the grid of 99,560MWh is calculated based on coefficient of effective electricity (85%) and auxiliary power consumption (0.5%):

$$99{,}560\text{MWh} = 117{,}720\text{MWh} \times 85\% \times (1\text{-}0.5\%)$$ [7]

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[4] The loss is equal to the difference between the "*designed annual power generation estimated in Feasibility Study Report according to the hydrological conditions in terms of water resource availability*" and the net power exported to the grid, including the difference between the "*(actual) power generation with considering the lack of absorption capability of the grid*" and the net power exported to the grid.

[5]The coefficient of effective electricity is the ratio of "*(actual) power power generation with considering the lack of absorption capability of the grid*" and "*designed annual power generation estimated in Feasibility Study Report according to the hydrological conditions in terms of water resource availability*"

[6] This institute is an independent organization which is qualified to compile design reports for hydropower projects (it has obtained a "grade C" in water conservancy industry, electricity industry and a "grade C" in engineering investigation industry, all issued by the Construction Bureau of Yunnan Province).

[7] In Section 3.2.1, 3.2.2, and 3.4 of the SL 16-95 regulation it is stated that the power supply to the grid by a project is calculated as the annual designed electricity generation × coefficient of effective electricity × (1 – auxiliary power consumption). The annual designed electricity generation × coefficient of effective electricity is the effective electricity generation (which is based on amongst others the load factor, the electricity balance of the local grid). Section 3.4 of SL 16-95 further specifically states that for simplification purpose, the coefficient of effective electricity can be chosen from the Table 3.4 in the SL 16-95 document.
In the formula,

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The calculation formula comes from approved Feasibility Study Report which in turn bases its calculation on the "the Economic Evaluation Code for Small Hydropower Projects (SL16-95)" (same guidance used by the design institute preparing the Feasibility Study Report). Therefore, the net power exported to the grid employed in the IRR calculation is reasonable.

- The coefficient of effective electricity of 85% comes from approved Feasibility Study Report and is further confirmed by the Hydro energy Design Code for Hydro Power Projects (SL76-94) approved by the Ministry of Water Resources of the People's Republic of China: [8]
  - For small scale hydropower stations (with an installed capacity up to 50MW), the coefficient of effective electricity and effective power generation should be calculated according to the Economic Evaluation Regulation for Small Scale Hydropower Projects (SL16-92), which was substituted by "the Economic Evaluation Code for Small Hydropower Projects (SL16-95)", whose in Table 3.4 provides an overview of applicable coefficients for energy efficiency as follows:

The coefficient of effective electricity for different type of hydropower stations:

Type of hydropower stations	The coefficient of effective electricity
1.Grid connected, annual/ multi-year regulating hydropower stations	0.95-1.00
2.Grid connected, seasonal regulating hydropower stations	0.90-0.95
3. Grid connected, monthly/weekly/daily/no regulating (run-of-river) hydropower stations	
The grid will take all electricity generated in rainy season and night	**0.80-0.90**
The grid will only take part of the electricity generated in rainy season and night	**0.70-0.80**
4. Not connected to the grid, Daily/No regulating capacity	0.60-0.70

  - The installed capacity of the project is 22MW and the project is a run-of-river hydropower station. In accordance with the Table 3.4 in "the Economic Evaluation Code for Small Hydropower Projects (SL16-95)" as listed above, the coefficient of effective electricity should choose 0.70-0.90. The Design Institute has chosen to employ the higher value of 0.85 as the coefficient of electricity. This is a comparatively *conservative* choice as a higher coefficient leads to higher power supply and therefore an overestimation of the IRR compared to employing a lower values as coefficient of electricity generation.
  - In addition, the coefficient of effective electricity is the result of the balance between the local grid absorption capability in the dry and rainy seasons, taking into consideration the demand for power in the two periods. In particular has been evidenced the coefficient of effective electricity reflects the conditions of insufficient water availability during

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- 117,720MWh is the designed annual power generation, which is estimated in Feasibility Study Report according to the hydrological conditions in terms of water resource availability;
- 117,720MWh × 85% is the power generation with considering the lack of absorption capability of the grid;
- 117,720MWh × 85% × (1-0.5%) is the net power exported to the grid.

In addition, the approved Feasibility Study Report of the project also used the formula.

[8] Please see: http://www.chinawater.net.cn/guifan/bz_pdf/SL76-94/05.pdf

the dry season (October to May of each year) and the condition of "over the grid capability" available power during the flood season (from June to September of each year). The result is a production which changes significantly throughout the year and in particular between the dry and the flood season, therefore affecting the annual electricity which will export to the grid. The potential power production which has been estimated in Feasibility Study Report according to the hydrological conditions in terms of water availability, does therefore differ from the actual power which will be generated, because full load conditions will be rarely set during the plant operation throughout the year due to the lack of absorption capability of the grid. In other words, during the flood season, a considerable hydropower potential, which in theory could allow the plant to reach 100% of the designed production, will be partially wasted due to the evidenced limits in the grid transmission and distribution system[9]

- ✧ Furthermore, the actual annual power generation of the project from January to December 2008 is 98,563.86MWh [10], while the annual power generation designed in Feasibility Study Report is 117,720MWh. Therefore, the actual coefficient of effective electricity is 83.73%, which is lower than the expected coefficient of effective electricity of 85% in Feasibility Study Report.

  Therefore, the coefficient of effective electricity of 85% in Feasibility Study Report is conservative and credible.

- ➢ The 0.5% for auxiliary power consumption is based on the "Economic Evaluation Code for Small Hydropower Projects (SL16-95)". According to this guidance, auxiliary power consumption is to be determined based on the actual situation or referred to from other similar projects. Based on "the regulation of development programming of electrical power in the region mainly supplied by rural hydropower (SL22-92)"[11], auxiliary power consumption has been determined as 0.5% by the independent design institute preparing the PDR. This is reasonable and in accordance with the public guidance.

  It can be concluded that the net power exported to the grid used in the IRR calculation is ***reasonable and conservative*** at the time of investment decision.

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[9] Notice for the coefficient of effective electricity, published by local grid company in 2005. The document has been validated by the DOE during the validation period. In this document, local Grid Company (which the project connected) issued an explanation and the reasons to prove the validity of the average coefficient of effective electricity of 83.59%. The main reasons are as following:

- ✧ Comparing with the construction of hydropower stations, the construction of power grid in Nujiang Lisu Autonomous Prefecture (where the project is located) is lagging behind and it is beyond the capability of the power grid. The bottleneck on power generation will exist in long period, and the decreasing trend on coefficient of effective electricity will last for a few years.
- ✧ The structure of the local grid is frail and the transmission load capacity is limited (which caused the abandoned water in rainy seasons), so the bottleneck on transmission is rather common. Therefore, these factors resulting that the grid effective electricity could not reach the design standard.
- ✧ Due to low absorption ability and the lower load of local grid, there is large amount of the surplus of electricity during the rainy season and the grid company is not able to buy all of the power that could potentially be generated by the plants, so that this surplus electricity could not be utilized efficiently.
- ✧ Therefore, the average coefficient of effective electricity of 83.59% is reasonable. The coefficient of effective electricity of 85% was employed by the project, it is conservative.

In addition, the explanation above can be confirmed by the Explanation of the Coefficient of effective electricity, published by local grid company in 2009.

[10] The power generation of the project in 2008

[11] Published by the Ministry of Water Resources of the People's Republic of China

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Conclusion

The net power exported to the grid is calculated based on the designed annual power generation (which is calculated on a strong and long-term (30 years) statistical basis of water resource measurements by the government), the *conservative* coefficient of effective electricity of 85% and formal public guidance on auxiliary power consumption (i.e. 0.5%). Therefore, the loss of 15% between the designed annual power generation and the net power exported to the grid is reasonable and conservative.

Response by DOE:

There are four main reasons which lead to the conclusion that a projected net export of electricity to the grid shall be 99,560 MWh per year, which will be discussed in more detail below:

1. The actual net export in year 2008 was proven to be below 99,560 MWh, leading to the conclusion that the applied 99,560 MWh can be seen as a conservative estimate in the CDM context.
2. The estimate is in compliance with the regulation as provided by the benchmark document.
3. Evidence has revealed that the power absorption capacity of the grid is limited due to various reasons.
4. The assumed net export of electricity to the grid is in line with the most recent meth panel guidance on the validation of power estimates.

On reason 1:
The coefficient of effective electricity supply to the grid mentioned in the PP's comment above is taken from the approved FSR. Specifically, the FSR mentions the value of Effective Electric Coefficient as 0.85 (85 %), power used by plant as 0.5 %, design annual power as 117,720 MWh and annual power supplied to grid as 99,560 MWh. Comparing this value with the actual power generation of the plant from January to December 2008, it can be noticed that the actual coefficient of effective electricity (83.73 %) is lower than the 85 % mentioned in the FSR. The value mentioned in the FSR can therefore be considered to be conservative (in terms of IRR calculation) and credible.

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On reason 2:
It is confirmed by entries in the Economic Evaluation Code for Small Hydropower Project (SL16-95) as given in the table below:

Effective factor

Type of hydropower station	Effective Factor
1.Grid connected, annual/pluriannual regulating stations	0.95-1.00
2.Grid connected, seasonal regulating stations	0.90-0.95
3. **Grid connected, monthly/weekly/daily regulating stations**	
The grid will take all electricity generated in rainy season and night	0.80-0.90
The grid will only take part of the electricity generated in rainy season and night	0.70-0.80
4. Not connected to the grid, Daily/No regulating capacity	0.60-0.70

Source: SL 16-95

As run of river project with monthly/weekly/daily regulating capacity, it was proven that the project activity belongs to category 3 in above table. Accordingly an effective factor of 0.7 to 0.9 should be applied.

On reason 3:
According to the study conducted by the grid company on 08.02.2005 and circulated under the title “Notice of explanation on the Coefficient of Effective Electricity from local Grid Company” (enclosure 2 to this response), the poor construction of transmission line and the connection with large grid (e.g South China Grid) through the 110 kV voltages lines with limited transmission load capacity, leads to significant losses. The result is that the grid effective electricity cannot reach the design standard. Furthermore, the industrial consumption in Local County is not large, and the surplus electricity has to be transmitted to distant grids; hence the transmitting distance is long and line losses are high. This document also states that “After the calculation on the actual average level of effective electricity and settlement grid price in all hydropower stations connecting to the grid in 2004, we have found that the average coefficient of effective electricity takes 83.59% of the annual average designed power generation…”

Similarly, according to “The Explanation of the Coefficient of effective electricity for Hydropower Stations in Nujiang Autonomous Prefecture” issued on 15.01.2009 by Yunan Nujiang Grid Company (enclosure 3 to this response), most hydropower stations in the local grid are stations without adjusting capability and the local grid is vulnerable; the absorption and transmission capacity is very limited. Therefore, the electricity generated by hydropower stations in rainy season cannot be all connected to the grid. This unavailability of the grid would lead to loss of surplus water resources. The report concludes that hydropower stations in local grid cannot operate under full load throughout the year. The selection of coefficient of effective electricity of 83% is reasonable. Therefore, the coefficient of effective electricity of 85% used in the PDD can be considered to be a conservative estimate.

The power supplied to the power grid was calculated by multiplying the power generation with the coefficient for the effective supply to the grid, then deduct the power loss for internal use

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and transmission loss. The project owner calculated the power supply to the power grid as the following formula:

Effective Power Generated = Design Power * Coefficient of Effective Electricity

Power fed into Grid = Effective Power Generated * (1 – Power used by plant %)

On reason 4:
Recently the meth panel was requested to elaborate the guidance on ACM0002, in particular how to arrive at an accurate plant load factor taking into account the variability of the wind parameters and gaps of data. Though this guidance was not yet discussed by the EB due to time constraints, and bearing in mind that this guideline is addressing wind power plants in particular, it is considered useful to assess effective power generation estimates also for hydro power. Among others, the following two recommendations were made (compare Meth panel report 35, para 37):

“After considering the case, the panel recommends the EB to consider the following options:

(a) The DOE should validate that the estimate in the CDM-PDD of the annual electricity generation is consistent with the estimate provided to banks and/or equity financiers while applying for project financing, or to the government while applying for implementation approval;

(b) The expected annual electricity generation of the project should be determined by a third party contracted by the project participants (e.g. an engineering company);”

Regarding recommendation (a) it can be confirmed by the DOE that the same net annual electricity generation was provided to the government while applying for the implementation approval, as could be evidenced by the approval of Feasibility study report by the design institute. Referring to recommendation (b) it can also be confirmed that the estimate was made by a third party which was contracted by the project participants, named Yunnan Lingyu Water Resource and Hydropower Investigation and Design Institute, holding a “grade C” in water conservancy industry, electricity industry and a “grade C” in engineering investigation industry, all issued by the Construction Bureau of Yunnan Province.

<u>Conclusion:</u>

Based on the four points mentioned above, TÜV SÜD can confirm that the method of calculation for power supplied to the grid is correct and transparent, and that the 15.5 % difference between power generation and power supply to the power grid is reasonable in the context of the project activity and the characteristics of the local Grid.